CHBE 412 901 Sp21

CHEMICAL AND BIOMOLECULAR ENG. (ChBE) 412

THERMODYNAMICS II – Spring 2021

MWF 9:45am - 10:40am Location: Initially Online Only

Professor: Walter G. Chapman (wgchap@rice.edu) Office: B-241 in Abercrombie Lab

Text: Smith, Van Ness, Abbott, and Swihart, Intro. to Chem. Eng. Thermo., 8th Ed.

Office Hours: Chapman: 4 – 6 pm Monday

TA: Thiago Pinheiro, (thiago.pinheiro@rice.edu)

TA: He Ze (zh23@rice.edu)

Lecture Topics	Lecture No.	Chapters
Vapor Liquid Equilibrium (VLE), Phase Diagrams, Raoult's		

law, Corrections to Raoult's law, K-Values, Flash Calculations	1-6	10, 12
Thermodynamics of Mixtures, Phase Equilibrium Criteria, Partial Molar Properties, Non-ideality in the Vapor and Liquid Phases, Azeotropes	7-14	10, 12, 13
Gibbs-Duhem Equation, Phase Rule, Henry's Law, Heat of Mixing	15-17	11, 13
Phase Stability, Liquid-liquid Equilibrium, Solid-liquid equilibrium	18-24	12, 15
Phase Equilibria from Equations of State	25-27	13
Chemical Equilibria: Homogeneous, Heterogeneous, and Multiple Reactions	28-33	14
Introduction to Binary Separations	34-39	Notes Provided
Special Topics: Statistical Mechanics, Molecular Simulation	40-42	16, Notes Provided

Grading:

Classroom Participation: 5%

Homework:	20%	
Computer Problems:	10%	
In Class Quizzes:	20%	Following each homework
Mid-term Exam	20%	March 9 or 11
Final Exam	25%	Open Book: TBA

Honor Code:

- Students are encouraged to talk to each other, the teaching assistants, and the instructor about any homework assignment in the course that is not specifically designated as pledged. This assistance is limited to the discussion of the problem and perhaps sketching of a solution. Submitted solutions to assignments may not be copied from any source.
- You are forbidden to look at tests from previous classes. Example test problems for study will be provided.
- The exams, quizzes, and attendance sheets are covered by the Rice honor code policy, and as such it is a violation of the honor code policy to misrepresent your

signature or the signature of another student on a quiz or attendance poll. Do not sign for another student.

Information about the Rice Honor System can be found at http://honor.rice.edu/

Late Penalties

- All assignments are expected to be submitted no later than the posted deadline unless an extension is approved well in advance by the instructor.
- Any assignment submitted later than the posted deadline will receive a penalty of 10%. For each 24 hours after the posted deadline, an additional 10% penalty will be added.

Attendance

- In accordance with the policy stated in the general announcements, attendance is required. Attendance is important for successful completion of this course. If any extenuating circumstances prevent your attendance, you are expected to notify the instructor by email in advance.
- If medical or other circumstance make advance notification impossible, you are

expected to submit justification for your absence in writing. Unexcused absence will result in a zero score for any quizzes or a reduction in the participation grade. Those excused from class are still responsible for all handout and lecture materials.

Special Needs

- Any student with a disability requiring accommodations in this course is encouraged to contact me after class or during office hours. Additionally, students should contact Disabled Student Services in the Ley Student Center.

CHBE 412 – Thermodynamics II

Course Objectives

Students will learn to:

1. Understand the thermodynamic relationships among mixture fluid properties
2. Understand the molecular basis for ideal and non-ideal systems
3. Understand thermodynamic stability as applied to phase splitting
4. Apply thermodynamics to multicomponent-multiphase equilibrium
5. Develop a feel for the range of applicability of various correlations

6. Understand the thermodynamics of chemical reacting systems
7. Apply combined phase and chemical equilibria to chemically reacting systems
8. Apply this knowledge to problems of industrial application

Course Outcomes

Students will be challenged to

1. Calculate changes in thermodynamic properties on mixing
2. Relate mixture properties to thermodynamic derivative properties
3. Correlate phase equilibria data using excess Gibbs free energy models
4. Calculate phase equilibria from an equation of state
5. Calculate the conditions of phase splitting and solve problems involving multiple condensed phases
6. Calculate chemical reaction equilibria for non-ideal systems
7. Calculate multi-component phase and chemical equilibria
8. Analyze simple problems involving distillation and VLE behavior

Program Objectives for the B.S. in Chemical Engineering

Within 3-5 years of graduation, Rice BSChE alumni will be:

1. Graduate students, professionals and entrepreneurs who are moving towards leadership positions as exemplary members of the global workforce; and
2. Professionals who practice their societal, environmental, and ethical responsibilities.